

CONF-960912--37

SAFETY CULTURE IN THE NUCLEAR VERSUS NON-NUCLEAR ORGANIZATION

RECEIVED

SEP 13 1988

OSTI

Sonja B. Haber
 Brookhaven National Laboratory
 Dept. of Advanced Technology
 Upton, NY 11973
 (516) 344-3575

Deborah A. Shurberg
 Brookhaven National Laboratory
 Dept. of Advanced Technology
 Upton, NY 11973
 (516) 344-2602

ABSTRACT

The importance of safety culture in the safe and reliable operation of nuclear organizations is not a new concept. The greatest barriers to this area of research are twofold: (1) the definition and criteria of safety culture for a nuclear organization; and (2) the measurement of those attributes in an objective and systematic fashion. This paper will discuss a proposed resolution of those barriers as demonstrated by the collection of data across nuclear and non-nuclear facilities over a two year period.

I. INTRODUCTION

The culture of an organization is comprised of the common values, attitudes, and beliefs of the individuals working within that organization¹. In particular, the notion of safety culture addresses those values and attitudes that deal with the working environment which are believed to be important influences on the operation of a facility and on the safety issues relevant to the organization. However, the criteria of what constitutes a "positive" safety culture, as opposed to a "negative" one is not so easily defined.

Safety culture is the representation of a management philosophy which reflects the values and attitudes of importance placed upon those processes within an organization which have significant consequences for safety. Safety can be defined as internal to the operation of the organization, or as in the case of a nuclear organization, can also be defined outside the organization with implications for the public sector. In addition to a management philosophy, certain personnel actions and conduct of operations practices must be in place to ensure that safety performance will result across the organization.

The notion of safety culture is most often heard within the discussion of high reliability organizations. High

reliability organizations are those organizations which cannot afford to make a mistake because the consequence of that mistake would have serious implications for safety², often public health and safety. Organizations included in this category relevant to this paper are nuclear organizations, those dealing with the handling, preparation, production, processing or use of nuclear material. Rochlin³ cites one characteristic that differentiates reliability seeking organizations from others as the quest for perfection. In the organization's search for perfection, behavioral requirements are imposed on employees which impact their orientation towards safety. Organizations which tend to demand such a behavioral orientation are those which perform activities that are viewed as inherently complex, demanded by society and therefore require the highest performance levels, and contain inherent technological hazards. Few would argue that nuclear organizations fulfill these requirements.

This is not to say that all nuclear organizations do in fact focus attention on safety at the necessary level. But rather, one might expect the technological factors which influence performance within the nuclear environment to shift the organizational orientation towards a safety culture more so than in non-nuclear and less hazardous organizations.

The work described in this paper provides an opportunity to further investigate hypotheses presented by the authors earlier⁴ with regard to the type of culture needed to ensure high levels of safety. Specifically, the authors have identified two primary strategies that organizations engaged in potentially hazardous work must have the ability to adopt. The first strategy is termed the anticipatory strategy and is characterized by reliance on an elaborate set of procedures based on comprehensive analyses and calculations to assist in responding to events. However, abnormal situations do have varying degrees of uncertainty

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

and therefore, the potential for surprises is present. The ad hoc organizational strategy is utilized when problems arise which have not been fully anticipated and requires the organization to be somewhat flexible and creative in responding to unanticipated circumstances.

While a nuclear organization may be required to respond to a situation with either one or both of these strategies, the nuclear organization must also be able to successfully transform from one strategy to the other, and in all likelihood the behaviors and values that would contribute to success within one strategy are not the same for the other strategy. It was hypothesized that different organizational cultures are needed for success within each strategy as well as successful transformation from one strategy to the next. This requires that individuals within the organization are able to reconcile the two sets of beliefs and expectations and rectify the discrepancies in emphasized organizational behaviors which exist.

Lengnick-Hall⁵ investigated the cultures of efficiency and innovation. If a parallel is drawn between efficiency and the anticipatory strategy and between innovation and the ad hoc strategy, one can hypothesize the types of culture which would facilitate or impede the organization's success in undertaking each of the accident response strategies. Specifically, the organizational behaviors found to lead to efficiency include shared values, common experiences, and an organizational versus job focus. This translates into homogeneity of perceived expectations which delineates a hierarchical chain of command and conventional values as being the more critical cultural element for the anticipatory strategy. Organizational innovation is best fostered by open lines of communication, organizational commitment, job satisfaction, and heterogeneity of organizational member skills. This type of culture, more team-work orientated with a de-emphasis on hierarchical levels and encouragement of open and collegial communications, is in direct contrast to the efficiency behaviors, and is likely to be more effective for an ad hoc strategy. It was concluded that the ability of an organization to effectively move from an anticipatory to an ad hoc strategy may well depend on the organization's ability to balance these two apparently dichotomous value sets. The organization most capable of making the necessary transition in an optimal manner may well exhibit some aspects of both cultural styles during normal operations.

Several researchers have used a survey as a tool to assess culture in an organization^{6,7}. The survey can be designed to query individuals on the various attributes believed to comprise culture, including safety culture. The use of a survey also provides a broad sampling of the individuals within an organization, more than can be

queried by interviews alone. By obtaining data from a large number of individuals, a more comprehensive picture of the organization can be obtained. In addition, the use of a survey provides a descriptive profile of the organization's culture at one point in time. The profile can then be used as a baseline point against which comparisons of other points in time can be made. Such comparisons may prove valuable and would help to measure changes in the culture, especially after organizational interventions have been implemented. Comparisons of the profiles can also be made across organizations. In particular, this paper uses the comparison of data between nuclear and non-nuclear organizations as a way of defining the criteria of safety culture for the nuclear organization.

In summary, the philosophy of management, the mission of the organization, and the strategic choices management makes, determine the culture of the organization. The aspect of culture most immediately affected by these factors is what is valued by the organization. The extent to which these values are recognized and shared reflects the strength of the organizations' culture. Organizational factors, along with these shared values, influence the operating structures of the organization, its human resource management practices, and the styles of its managers and supervisors. To the extent that these shared values and behavioral norms can be measured and evaluated using a survey instrument, data collection of this type is important in understanding the organizational factors that influence safety performance.

II. METHODOLOGY

The attributes of organizational culture are defined in the Organizational Survey (OS). The OS is comprised of the Organizational Culture Inventory (OCI)⁸, consisting of 12 scales which describe three different cultural styles, 4 scales which assess various aspects of the communication process, and scales which assess commitment to the organization, cohesiveness of work group, coordination of the work, overall job satisfaction, perceived hazardous nature of work, and attention to safety. Below are descriptions of each of these scales.

A. Organizational Culture Inventory

The OCI is a paper-and-pencil diagnostic system for measuring the aspects of organizational culture that have the greatest impact on the activities of members and the functioning of the organization. Respondents are asked to review 120 statements which describe some of the thinking and behavioral styles that members of an organization may be expected to adopt in carrying out their work and in interacting with others. These statements comprise 12

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

different cultural scales which measure 3 different cultural styles. Some of the scales and styles are indicative of a positive and supportive environment, while others are useful in identifying potentially dysfunctional environments. All of the scales measured by the OCI are related to, and result from, organizational structural variables, reward systems, managerial styles and philosophies, and other factors that can be changed, at least to some extent, by those in leadership positions.

The 12 organizational culture scales, with examples of the items used to assess each one, are described below.

C1. Humanistic-encouraging. Organizations which are managed in a participative and person centered way. Members are expected to be supportive, constructive, and open to influence in their dealings with one another.

- Involving subordinates in decisions;
- Showing concern for the needs of others.

C2. Affiliative. Organizations which place a high priority on constructive personal relations. The members are expected to be friendly, open, and sensitive to the satisfaction of their work group.

- Thinking in terms of the group's satisfaction;
- Using good human relations skills.

C3. Approval. Organizations in which conflicts are avoided and personal relations are pleasant, at least superficially. Members feel they should agree with and gain approval of others.

- Staying on the good side of superiors;
- Making sure people accept you.

C4. Conventional. Organizations that are conservative, traditional, and bureaucratically controlled. Members are expected to conform, follow rules, and make a good impression.

- Always following policies and practices;
- Avoiding confrontations.

C5. Dependent. Organizations that are hierarchically controlled and non-participative. Centralized decision making leads members to do only what they are told and to clear all decisions with superiors.

- Accepting goals without questioning them;
- Never challenging superiors.

C6. Avoidance. Organizations that do not reward success but punish failure. Negative rewards lead members to shift responsibility to others and avoid being blamed for mistakes.

- Taking few chances;
- Laying "low" when things get tough.

C7. Oppositional. Organizations in which confrontation prevails and negativism is rewarded. Members gain status and influence by being critical and are encouraged to oppose the ideas of others.

- Pointing out news;
- Remaining aloof from the situation.

C8. Power. Non-participative organizations which are structured on the basis of authority in members' positions. Members expect to take charge, control subordinates, and respond to demands of superiors.

- Demanding loyalty;
- Acting forceful.

C9. Competition. Organizations where winning is valued and rewards are given for out-performing others. Members operate in a "win-lose" framework and work against their peers to be noticed.

- Always trying to be right;
- Out-performing one's peers.

C10. Perfectionistic. Organizations in which persistence, hard work, and perfectionism are highly valued. Members feel they must avoid all mistakes, keep track of everything, and work long hours to attain specific objectives.

- Setting unrealistically high goals;
- Viewing work as more important than anything else.

C11. Achievement. Organizations that do things well and value members who set and accomplish their own goals. Members set challenging, but realistic goals, and plan and pursue them with enthusiasm.

- Exploring alternatives before acting;
- Pursuing a standard of excellence.

C12. Self-actualizing. Organizations that value creativity, quality over quantity, tasks, and individual growth. Members are encouraged to gain satisfaction from their work, develop themselves, and take on new activities.

- Thinking in unique and independent ways;
- Communicating ideas.

From these twelve scales, three cultural styles are described. The first style is comprised of the Humanistic-Encouraging (C1), Affiliative (C2), Achievement (C11), and Self-Actualizing (C12) Scales. These scales are considered "Constructive Styles;" in other words, organizations which score high on these four scales tend to promote behaviors which are conducive to the satisfaction of the organizational members.

The second cultural style is the "Passive/Defensive Style." This style is made up of the Approval (C3),

Conventional (C4), Dependent (C5), and Avoidance (C6) Scales. In organizations which score high on these scales, a culture exists which leads employees of the organization to act and react in a defensive way and at the same time, act in a way which does not pose a threat to one's own security within that organization.

A third cultural style is made up of the Oppositional (C7), Power (C8), Competitive (C9), and Perfectionistic (C10) Scales. Organizations which score high on these scales often expect members to act in a way that is forceful and that protects one's position and status. In other words, members adopt an "Aggressive/Defensive Style" in order to be successful within the organization.

B. Communication Scales

Communication is a critical process for effective operations in any organization. However, because it is a process rather than a variable, it is very difficult to measure. The scales used in the questionnaire administered at the Department of Energy facilities were developed by Roberts and O'Reilly⁹. They have been administered to various organizations with good reliability and success in analyzing several facets of the communication process.

Four communication scales were administered and are described below.

1. Trust. Freedom to discuss the problems and difficulties in the job with an immediate supervisor without jeopardy.

2. Accuracy. Perception of the accuracy of information received from other organizational levels (superior, same, and subordinate levels).

3. Interaction. Desirability of frequent contact with others in the organization (superiors, same, and subordinates).

4. Satisfaction. Overall satisfaction with the communication process in the organization.

C. Additional Scales

1. Commitment scale. The Commitment Scale is defined as the relative strength of an individual's identification with and involvement in a particular organization¹⁰. This commitment extends to the goals of the organization and the desire to maintain membership in the organization to facilitate these goals.

2. Cohesion Scale. The Cohesion Scale is very similar to the Commitment Scale except that it is defined as the relative strength of an individual's identification with and involvement in a particular work group^{11,12}.

3. Coordination Scale. The Coordination Scale assesses the employee's perception of the degree to which the subunits of an organization operate according to the requirements of each other and of the total organization¹³.

4. Job Satisfaction. The Job Satisfaction Scale¹⁴ refers to employees' overall satisfaction with their jobs. While it is not able to point to specific aspects of the working environment which people are satisfied or dissatisfied with, it can help to determine if employee satisfaction is something which needs further consideration by management.

5. Hazard Scale. The Hazard Scale is used to identify people's perception of the hazardous nature of their work¹⁵.

6. Safety Scale. The Safety Scale, developed by researchers at the University of California at Berkeley¹⁶, is used to assess an individual's perception of the importance of safety to success in an organization. Safety is defined as operating in a manner to ensure that the probability of making a mistake is low, because the consequence of making a mistake is high.

Over a period of two years, several administrations of the OS were conducted for various projects. Included in the OS database are 12 Department of Energy facilities, two U.S. commercial nuclear power plants and one commercial fossil fuel plant. Over 11,000 individuals are represented in the database. In some organizations, 100 percent of the organization was sampled, while in the very large organizations (greater than 3,000 individuals), a 20% randomly selected sample of the organization was surveyed.

The results presented in this paper are based upon the responses to the OS from employees of nine different Department of Energy facilities. These nine organizations could be easily categorized into nuclear or non-nuclear based upon their primary operations. The remaining three Department of Energy facilities in the OS database had multifunctional purposes and a clear categorization was not possible. The other organizations in the OS database, the nuclear power plants and fossil plant were not included in the analyses for this paper. All of the organizations included in the analyses for this paper are either owned or operated by the Department of Energy providing a more uniform basis for purposes of comparison. The population of data used in this paper consists of 7283 responses. Four of the

nine facilities used in this analysis were categorized as nuclear organizations.

The original purpose of the data collection was for individual organizational analysis on the OS. Individual technical reports exist for each of the Department of Energy facilities surveyed¹⁷. In those reports, overall means, standard errors, and standard deviations were computed for each scale assessed in the OS. A one-way analysis of variance was also performed on each scale using the scale score as the dependent variable and separate analyses using organizational groups as the independent variables. For the purposes of this paper, mean scores are presented for the combined nuclear and combined non-nuclear organizations. Qualitative comparisons and trends among the nuclear

versus non-nuclear organizations are discussed. Statistical analyses on these means would not be justified by a priori hypotheses developed prior to data collection.

III. RESULTS

The differences between the nuclear and non-nuclear organizations on the scales of the OCI are depicted in Figure 1. Nuclear organizations tended to score higher on those scales comprising the Constructive Cultural Style, while non-nuclear organizations scored higher on those scales comprising the Passive/Defensive Cultural Style. Both organizations scored relatively equally on the Aggressive/Defensive Style.

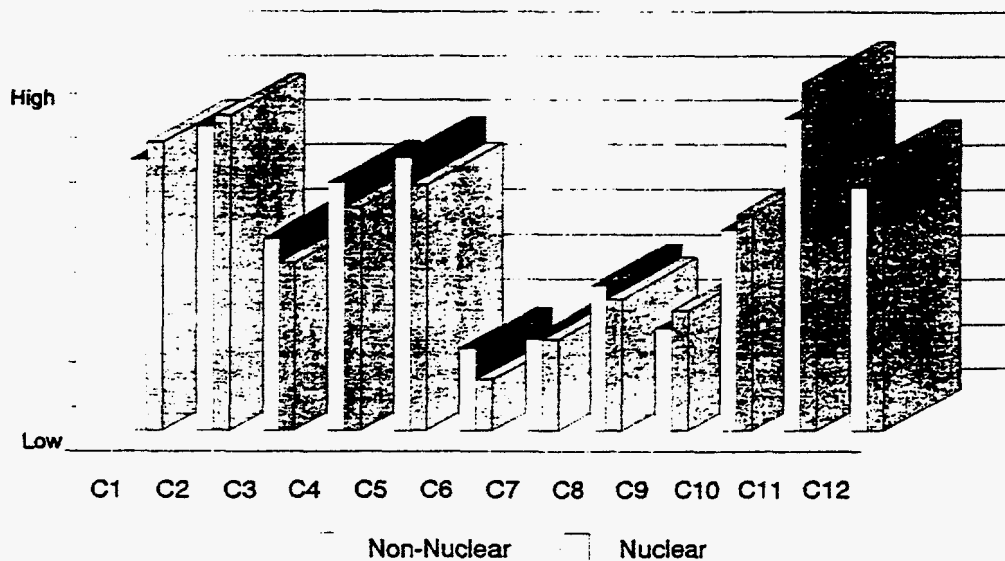


Figure 1. Differences Between Nuclear and Non-Nuclear Organization on the Organizational Culture Inventory.

The differences between the nuclear and non-nuclear organizations on the communications scales are depicted in Figure 2. The nuclear organizations scored consistently higher on all four of the communications scales administered. The largest difference was on the communications accuracy scale.

The differences between the nuclear and non-nuclear organizations on the additional scales are depicted in

Figure 3. On all of the additional scales administered, Commitment, Cohesion, Coordination, Job Satisfaction, Hazard, and Safety, the nuclear organizations scored higher than the non-nuclear organizations. In some cases, like Cohesion and Job Satisfaction, the differences were small but in the same direction. For the Coordination Scale, the differences were somewhat larger.

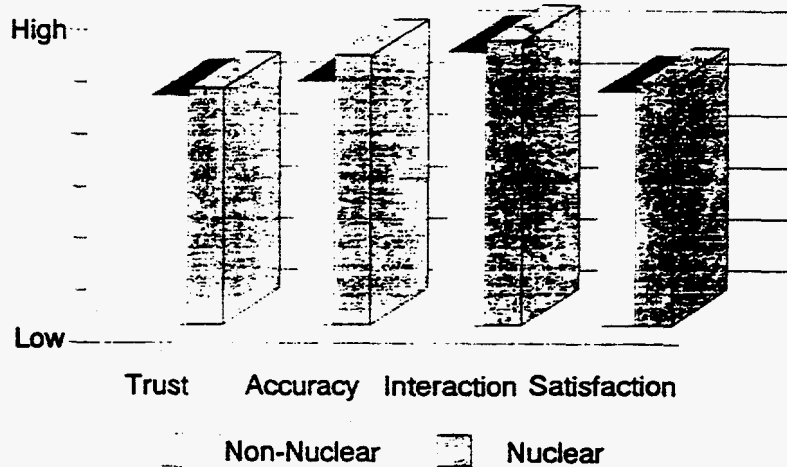


Figure 2. Differences Between Nuclear and Non-Nuclear Organization on the Communication Scales.

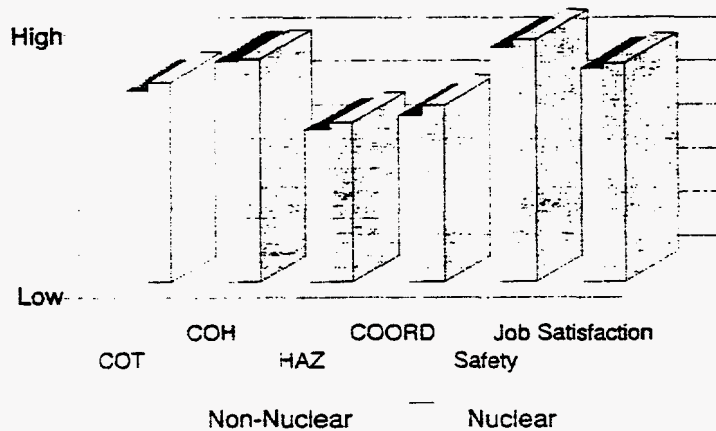


Figure 3. Differences Between Nuclear and Non-Nuclear Organization on Additional Scales.

IV. CONCLUSIONS

This paper focused on the differences obtained between organizations categorized as nuclear or non-nuclear on the Organizational Survey (OS). Although the analysis conducted for this paper was not the original focus of the data collection effort, the comparison provides interesting insights into the potential differences between nuclear and non-nuclear organizations on organizational culture, especially those related to safety culture.

The literature seems to indicate that organizations which seek high reliability and must be able to mitigate circumstances with significant safety implications possess certain characteristics which differentiate them from other types of organizations. The category of nuclear organizations as defined in this paper fits into the high reliability organization profile. The pattern of results obtained between the nuclear and non-nuclear organizations, demonstrates a consistency towards the behavioral characteristics previously identified in the literature for these organizations.

The notion that high reliability organizations seek perfection and that this results in an organizational orientation towards a safety culture more than non-nuclear and less hazardous organizations is supported by the results obtained. In particular, the nuclear organizations scored higher than the non-nuclear organizations on the Perfectionistic Scale of the Organizational Culture Inventory. This scale explicitly measures the value placed upon persistence, hard work, and perfectionism. In addition, the nuclear organizations scored higher on the Safety Scale which is used to assess the perception of the importance of safety to success in the organization.

With respect to the previously identified hypotheses by the authors concerning the type of culture needed to ensure high levels of safety within an organization, the results of this analysis provide some support to the idea that the nuclear organization may favor the ad hoc or innovative strategy. The nuclear organizations scored consistently higher on the Constructive Cultural Style Scales of the OCI. These scales are indicative of an organization whose culture promotes behaviors which are conducive to the satisfaction of the organizational members and emphasizes a more people-oriented and teamwork environment. In addition, the nuclear organizations scored consistently higher than the non-nuclear organizations on the Communications Scales which measure the trust, accuracy, desire for interaction, and overall satisfaction with the communication processes in the organization. The nuclear organizations also scored higher on commitment and job satisfaction. All of these behaviors are consistent with the innovative strategy.

The non-nuclear organizations scored consistently higher on the Passive/Defensive Cultural Style of the OCI. This style is indicative of an organization in which the culture facilitates employees to act and react in a defensive way and yet not pose any threat to one's own security or position in the organization. The style has characteristics similar to the efficiency culture where there is an expectation of a hierarchical chain of command and conventional values as being the critical cultural elements. This type of cultural style was also identified in the fossil fuel organization previously surveyed by the authors.

Although not necessarily statistically significant, the results obtained in this analysis are consistent in trend and pattern with previously obtained data and hypotheses identified in the literature. These results present another step in the definition and criteria of safety culture for a nuclear organization. It appears that a safety culture is one in which management expectations promote behaviors which strive for perfection, with an orientation of attention to safety, but not at the expense of the satisfaction of the members of the organization. The organizational culture is one in which individuals are committed and satisfied with their jobs and the organization, and communication is an open and effective process.

The implications for risk-informed regulation from the results of this study are the identification of those organizational attributes important to safety culture as derived from empirical data and not subjective evaluation. In addition, the methods described in this paper can provide a tool for the further objective and systematic assessment and quantification of those significant attributes.

REFERENCES

1. R. A. Cooke and E. H. Burack, "Measuring Norms and Expectations With the OCI," Organizational Culture Inventory, Level V Manual, p. 13, Human Synergistics, Chicago, Illinois (1987).
2. K. H. Roberts, "Introduction," In: New Challenges to Understanding Organizations, K. H. Roberts (Ed.), p. 1, MacMillan Publishing Co., New York, New York (1993).
3. G. I. Rochlin, "Defining 'High Reliability' Organizations in Practice: A taxonomic Prologue," In: New Challenges to Understanding Organizations, K.H. Roberts (Ed.), p. 11, MacMillan Publishing Co., New York, New York (1993).

4. D. A. Shurberg and S. B. Haber, "Organizational Culture and the Accident Response Process," BNL-NUREG-47342, also presented at the 1992 ANS Topical Meeting on Risk Management, Boston, MA (1992).
5. C. A. Lengnick-Hall, "Fit and Misfit: How to Achieve Efficiency and Innovation," Organization Development 6, 67 (1988).
6. G. Hofstede and M. H. Bond, "The Confucius Connection: From Cultural Roots to Economic Growth," Organizational Dynamics, 16, 4 (1988).
7. R. H. Kilmann, Beyond the Quick Fix, Jossey-Bass, San Francisco, CA (1984).
8. Human Synergistics, Organizational Culture Inventory, Level V, Survey Instrument, Plymouth, MI, 1987.
9. K. M. Roberts and C. A. O'Reilly, "Measuring Organizational Communications," Applied Psychology, 59, 321 (1974).
10. R. Mowday and R. M. Steers, "The Measurement of Organizational Commitment," Vocational Behavior, 14, 224 (1979).
11. J. L. Price, Handbook of Organizational Measurement, p. 321, DC Heath and Co., Lexington, MA (1972).
12. S. E. Seashore, Group Cohesiveness in the Industrial Work Group, Survey Research Center, University of Michigan, Ann Arbor, MI (1954).
13. B. S. Georgopolous and F. C. Mann, The Community General Hospital, Macmillan, New York, New York (1962).
14. J. Kunin, "The Construction of a New Type of Attitude Measure," Personnel Psychology, 8, 65 (1955).
15. K. H. Roberts, Personal communication (1990).
16. K. H. Roberts, Personal communication (1989).
17. D. A. Shurberg and S. B. Haber, "An Organizational Survey of the Strategic Petroleum Reserve," BNL Technical Report No. 47380, Brookhaven National Laboratory, Upton, NY (1992).

This work performed under the auspices of the U.S. Department of Energy, under Contract No. DE-AC02-76CH00016.